METHYL BROMIDE PROCEDURES FOR GREENHOUSE FUMIGATION

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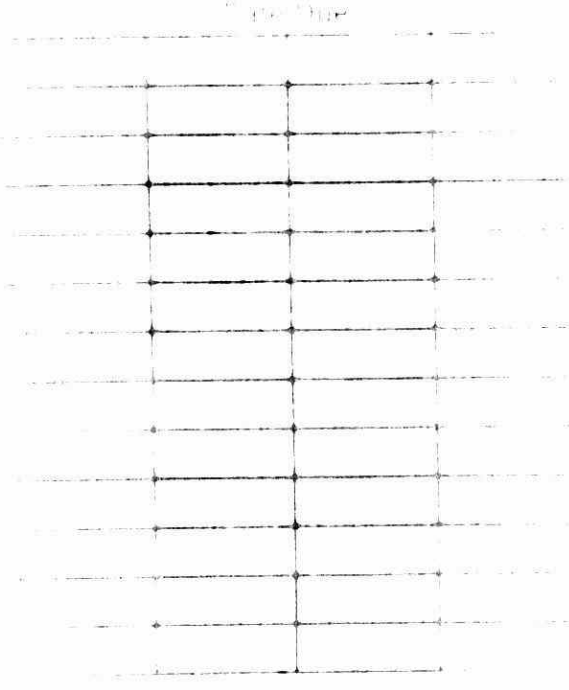
Ontario

Ministry of the Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister



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PESTICIDES CONTROL SECTION

MINISTRY OF THE ENVIRONMENT

THIS PUBLICATION HAS BEEN ENDORSED BY THE ONTARIO PESTICIDES ADVISORY COMMITTEE

PHYSICAL PROPERTIES OF METHYL BROMIDE

Common Name	Methyl Bromide
Formula	CH_3Br
Commercial Grades	Not less than 99.4% pure
Physical State	Gas at normal temperature and pressure. Liquid under pressure in cylinders or cans at normal temperature.
Flammability limits in air	nonflammable
Critical Temperature	381.2°F (194°C)
Boiling Point	40.3°F (4.6°C) at 760 mm. Hg.
Freezing Point	- 135.4°F (- 93°C)
Colour	Colourless
Pertinent chemical properties	Powerful solvent of organic materials, especially natural rubber. When pure, non-corrosive to metals. The methyl bromide liquid reacts with aluminum and the compound formed ignites spontaneously in the pressence of oxygen.
Odour	Odourless except for relatively high concentrations which have a sweet, chloroform-like odour.
Solubility in Water	1.75 g/100 g. at 20°C, 748 mm.Hg. (very slight)
Specific Gravity of Liquid	1.732 at 32°F (0°C) and 760 mm.
Threshold Limit Value (Skin)	15 ppm or 60 mg/M^3 (ACGIH-1974).
Specific Gravity of Gas (Air = 1)	3.27 at 32°F (0°C) and 760 mm.

It should be stated at the beginning that methyl bromide is only one of several fumigants that can be used for soil sterilization in a greenhouse. The method is efficient and simple to use provided that the person has all the equipment necessary and follows the procedures in proper sequence. If the variation is made in the latter it is only an invitation for an accident. Because of the toxic nature of methyl bromide, you cannot afford an accident. Since methyl bromide is odourless, chloropicrin is used as a warning gas, a formulation of 98% methyl bromide with 2% chloropicrin is normally used. Because chloropicrin is phytotoxic, methyl bromide containing this gas as a warning agent should not be used on nursery stock or other living plants.

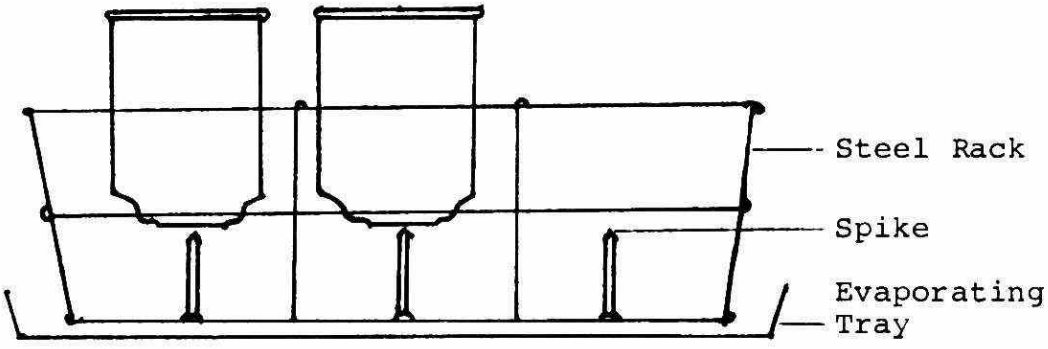
METHOD A

Equipment Needed

1. Polyethylene tarp or similar plastic tarp large enough to cover the bed with a few feet extra.

2. A welded steel rack with sharp spikes or nails welded to the bottom. The steel rack should have compartments large enough to hold a can of methyl bromide in an upright position. The entire steel rack should have a height less than the height of a can of methyl bromide.

3. A board large enough to completely cover the steel rack.



4. Self-contained breathing apparatus or gas mask - full face piece (industrial) plus canister approved by U.S. Bureau of Mines and/or NIOSH for methyl bromide.

5. Halide leak detector.

6. Metal trays to be used as evaporators.

7. One adult assistant.

8. Locks for the door or doors.

9. Signs - 14" x 10" wide with red letters on a white background, saying a dangerous gas is being used inside.

10. Masking tape to seal leaks in tarps.

11. Fan(s) within greenhouse with outside switch control (16" fan per 50,000 cu. ft.).

There are two common procedures used. In one method, the flats are stacked in a pile and fumigated; in the other method the bed is fumigated as is, on the ground. In both cases the procedure is very similar and certain conditions are the same - i.e. the soil should be loose, and not compacted and at 60° F (18°C) minimum.

Procedure

Beds

1. A trench is made around the bed 8" to 10" deep.

2. The required number of cans of methyl bromide are inverted in the rack so that the top of the can is touching the sharp point of the spike so that when pressure is applied later, the can will be pierced. The rack with the cans should be placed on an evaporating tray centrally located on top of the bed. If the rate of application is 1-lb. per 100 sq. ft., one 1-lb. can should be placed in the rack for every 100 sq. ft. under the tarp. See dosage table page 8.

3. The board should be placed evenly over the cans then the tarp should be drawn over the cans, steel rack and soil beds.

4. The edge of the tarp should be placed in the trench and the earth tamped in tightly. In doing this operation make sure the tarp is taunt over the bed allowing for good movement of the gas between the tarp and the bed. Similarly seal and secure each end of the bed.

5. An approved sign - 14" x 10" wide, saying a dangerous gas is being used inside, should be posted on all entrances to the greenhouse. An approved gas mask or self-contained breathing apparatus should always be worn whenever there is any possibility of exposure to methyl bromide.

6. At this stage an approved gas mask or approved self-contained breathing apparatus should be put on by the exterminator and the assistant exterminator, both masks should be checked for leaks before entering the greenhouse (see section on gas masks). The exterminator must never enter the greenhouse unaccompanied in case of an accident.

7. A check should be made to ensure that no humans or animals are in the greenhouse.

8. When the temperature is between 65°F to 70°F (18.3°C to 21.1°C) and with the assistant standing at the door, the exterminator applies an even pressure on the tarp over the board in order to pierce the cans of methyl bromide to release the gas under the tarp.

9. The exterminator with his gas mask or self-contained breathing apparatus still on accompanied by his assistant with his gas mask should take the halide leak detector and (1) test the edges for leaks, and (2) test the tarp itself for pin hole leaks. Any leaks must be sealed immediately. Leaks around edges may be sealed by tamping down the earth more efficiently. Leaks in the tarp may be sealed by covering with masking tape.

10. The exterminator and the assistant exterminator now leave the greenhouse and all the doors are locked. The keys to the doors are kept in the possession of the exterminator.

METHOD B

Alternate Method for Release of Methyl Bromide

Equipment Needed

1. Same as for Method A except no steel rack or board.

2. Polyethylene tubing 1/8-in. in diameter.

3. Stones, weights, etc., to be used to anchor one end of tubing in the evaporator trays.

4. Something to keep the tarp suspended at least 6-in. above the soil surface. This could be 1" x 2" strapping supported by stakes horizontally down the middle of the bed, or upended flower pots, crumpled fertilizer bags, racks filled with hay, etc.

5. A Jiffy applicator - may be obtained from your supplier of methyl bromide.

The methyl bromide must be heated to about 60°F (18°C) to 70°F (21.1°C). This may be done by immersing cans of methyl bromide in hot water.

Procedure

Beds

1. A trench is made around the bed 8" to 10" deep.

2. One edge of the tarp is placed in the trench and the earth tamped in tightly.

3. Supports are placed down the centre of the bed in order to keep the tarp suspended at least 6-in. above the soil.

4. Evaporating trays are placed in the middle of the bed. If the rate of application is 1-lb. per 100 sq. ft., one tray should be placed for every 100 sq. ft. If the rate is 1½-lb. per 100 sq. ft., place a tray about every 66 sq. ft.

4. Note: the square footage is obtained by multiplying the width of the bed times the length. Therefore, if you were applying 1-lb. per 100 sq. ft. and the bed was 4 ft. wide, you would place an evaporating tray every 25 ft. of bed. See dosage table page 8.

5. Take a piece of 1/8-in. tubing of sufficient length to reach easily from the evaporating tray to the outside of the bed. Affix one end in the evaporating tray by means of the weight or stone (item 3 in equipment needed).

6. Make a similar trench 8" to 10" deep in the ground on the corridor side of the bed. Put the other edge of the tarp in this trench and tamp the earth down tightly. In doing this operation make sure the tarp is taut over the bed, allowing for good movement of the gas between the tarp and the bed. The end of the 1/8-in. tubing should be easily accessible outside this side of the tarp but with the earth well tamped around it to give a good seal. Similarly, seal and secure each end of the bed.

7. An approved sign - 14" x 10" wide, saying a dangerous gas is being used inside, should be posted on all entrances to the greenhouse. An approved gas mask or self-contained breathing apparatus should always be worn whenever there is any possibility of exposure to methyl bromide.

8. At this stage an approved gas mask or approved self-contained breathing apparatus should be put on by the exterminator and the assistant exterminator, both masks should be checked for leaks before entering the greenhouse (see section on gas masks). The exterminator must never enter the greenhouse unaccompanied in case of an accident.

9. A check should be made to ensure that no humans or animals are in the greenhouse.

10. You are now ready to release the gas. Taking into consideration the necessity of maintaining a sufficient temperature in the greenhouse if possible, the doors should be open during the release of the gas. With the assistant exterminator standing at the door, the exterminator by means of the Jiffy applicator will release the methyl bromide through each piece of tubing.

11. When all the gas has been released, remove the tubing and seal this opening by tamping the earth about it. The exterminator with his gas mask or self-contained breathing apparatus still on accompanied by his assistant with his gas mask should take the halide leak detector and (1) test the edges for leaks, especially where the tube was removed, and (2) test the tarp itself for pinhole leaks. Any leaks must be sealed immediately. Leaks around edges may be sealed by tamping down the earth more efficiently. Leaks in the tarp may be sealed by covering with masking tape.

12. The exterminator and the assistant exterminator now leave the greenhouse and all the doors are locked. The keys to the doors are kept in the possession of the exterminator.

Airing Out

The exposure period may vary from 24 hours to several days depending on the concentration of gas and the temperature. The steps in sequence for airing out are as follows:

1. With an assistant with his gas mask or self contained breathing apparatus on, standing by, the exterminator with his gas mask on will open the doors and turn on the fans of the greenhouse.

2. He should check the greenhouse with the halide leak detector to see if there is a build up of methyl bromide, especially in the bottom corners of the greenhouse. If none is evident, he will proceed to the next step.

3. With his gas mask or self contained breathing apparatus still in place, he will remove the tarp being careful not to damage it, so that it may be used for another season or on other beds.

4. He then steps out for a few hours to allow the gas to disappear.

5. He will enter again with his mask on and the assistant by the door, check the fumigated bed to see if there is any sign of gas. He will keep the greenhouse under his custody and control until the halide leak detector shows no evidence of gas.

Flats

When flats are piled for the purpose of fumigating the soil, they should be piled loosely to allow good permeation by the gas. The tarp should be suspended approximately 6" above the top of the pile and an evaporating tray and plastic tubing placed at the top under the tarp, similar to the method detailed for bed fumigation. The edges of the tarp may be sealed in earth, similar to bed fumigation, or if the fumigation is being done on a concrete floor, sand snakes may be used to hold the tarp down. Note: A snake is a long cylindrical bag (about 6" to 8" in diameter) filled with sand. The size of the piles should be about 1000 cu. ft. as the dosage rate is 1 to 2 lbs. per 1000 cu. ft. All other procedures and precautions should be the same as in bed fumigation.

Gas Masks and Self Contained Breathing Apparatus

An approved gas mask or an approved self contained breathing apparatus should always be worn whenever there is any possibility of exposure to methyl bromide. Gas masks or self contained breathing apparatus should be approved by the U.S. Bureau

of Mines and/or the National Institute for Occupational Safety and Health (NIOSH) for use in a methyl bromide atmosphere. If you require any help in choosing protective equipment, you should contact the Pesticide Control Personnel, Ministry of the Environment in your area.

Before entering an atmosphere containing methyl bromide, be sure to check the mask for leaks. To do this, put on the mask with the canister attached. Place a hand over the hole in the bottom of the canister and inhale. If perfectly tight, the face mask will collapse. Canister gas masks are only air purifying devices, therefore, it is essential that they are used in atmospheres which contain sufficient oxygen to support life (more than 16% at sea level) and which contain generally no more than 2% concentration of methyl bromide by volume. If the specific exposure concentrations are suspected of exceeding the above limitation, only a self contained breathing apparatus should be used.

The operational life of a canister can vary from several minutes to an hour depending on the design and/or the concentration to which it has been exposed. Once the canister becomes saturated with methyl bromide it no longer protects the wearer.

Unless the maximum time that a canister should be used in a methyl bromide fumigation can be pre-determined, a canister once used, should be discarded for there is no sure way of determining the residual protection remaining in that canister.

Determination of Methyl Bromide Gas

The Halide Leak Detector is the most useful means of determining the absence or presence of harmful concentrations of methyl bromide gas. This detector operates with an acetylene gas flame. In air containing methyl bromide, a green or blue flame will be seen in the torch depending on the concentration of methyl bromide.

The following table gives the approximate methyl bromide concentration associated with colour intensity in the flame.

Methyl bromide present in p.p.m.	Reaction of flame
0	Very light blue
10	Very faint green tinge at edge of flame
20	Light green edge to flame
30	Light green flame
100	Moderate green
200	Intense green, blue at edge
500	Blue green
1000	Intense blue

If the gas is detectable with your halide leak detector, it is not safe for any person to be in the area without a suitable gas mask.

Handling Precautions for Methyl Bromide

As methyl bromide is an extremely toxic chemical it should only be handled by qualified personnel. As methyl bromide penetrates ordinary rubber gloves, these should not be used in the presence of methyl bromide.

Human Exposure to Methyl Bromide

On prolonged contact with the skin, a blister commonly forms which is not unlike the blisters resulting from thermal burns or severe chilling. Burns resulting from exposure to methyl bromide should be left alone and the affected person should see his physician.

The following are possible symptoms of methyl bromide exposure:

Nausea and vomiting
Dizziness or headache
Weakness
Slurred speach
Blurred vision
Difficult breathing
Convulsions

At the first sign of any of the above symptoms the effected person with his assistants should immediately get out of the fumigation area and into the fresh air. Symptoms may not show up until 48 hours after exposure.

The patient should be kept warm and the doctor called immediately. If the patient stops breathing administer artificial respiration until a doctor arrives and takes charge. There is no antidote. The booklet containing procedure for "First Aid and Treatment for Methyl Bromide Exposure" should be given to the doctor who takes charge of the patient. This booklet is available at your local dealer or Dow Chemical Company. However, it should be supplied by the dealer with each sale of methyl bromide.

SUGGESTED DOSAGE TABLE FOR A FORMULATION OF 98% METHYL BROMIDE WITH 2% CHLOROPICRIN

Control Desired	Dosage	Minimum Exposure	Aeration Time Before Seeds
SEED BEDS Insects in all life stages, weeds and weed seeds, nematodes	1-lb. per 100 sq. ft.	24 hrs.	24 hrs.
TURF RENOVATION, (Athletic Fields, Golf greens, Lawns, Parks) fungi, nematodes and soil insects (grubs, wire-worms) grasses and weeds	1-lb. per 100 sq. ft.	24-48 hrs.	24-72 hrs.
WELL ROTTED COMPOST & MANURE fungi, nematodes and soil insects (grubs, wireworms) grasses & weed seeds	½-lb. per cubic yd.	24 hrs.	72 hrs.or longer
MULCHING MATERIALS fungi, nematodes & soil insects (grubs, wireworms) grasses and weed seeds	1-lb. per 4 Bales	48 hrs.	72 hrs.

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